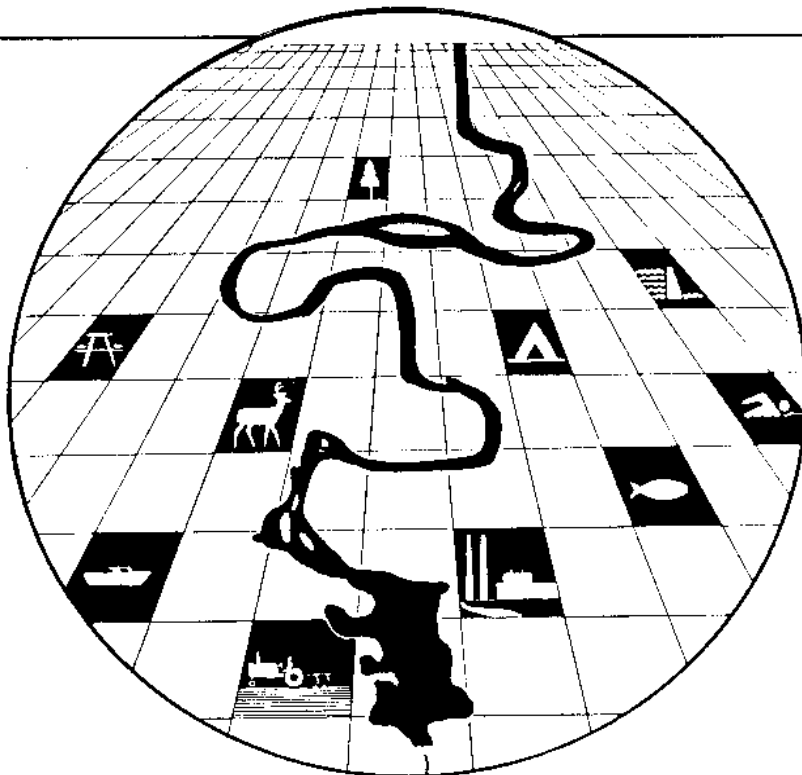


NICKAJACK RESERVOIR PLAN

Reservoir Description



RESERVOIR DESCRIPTION

The following description of the reservoir area was drawn from the planning data base and reflects the existing condition of the reservoir area as of October 1987, unless otherwise indicated.

HISTORICAL OVERVIEW

Nickajack Reservoir occupies a 46-mile section of the Tennessee River that stretches from the city of Chattanooga, Tennessee, to the mouth of the Sequatchie Valley. Archaeological studies indicate that man has occupied this area for several thousand years, culminating with the historic Creek and Cherokee Indians. Hernando de Soto and his expedition were most likely the first white men to see this land as they came through the area in the summer of 1540 on their way to the Mississippi River. Native Americans remained the primary inhabitants of the reservoir area until white settlers began to encroach upon the new frontier in the early 1800s. In fact, the Cherokee were so entrenched in the region that the Tennessee River was commonly referred to as the "River of the Cherokees."

The Cherokee had all claims to the land in the reservoir area; however, white immigration was encouraged by both the Federal and State governments. While early treaties enabled whites to inhabit some parts of the Sequatchie Valley, it was the Jackson and McMinn Treaty of 1817 that opened up settlement of Marion County by deeding land from the Cherokee to the United States Government. From this land the State of Tennessee created Marion County on November 20, 1817.

In 1824 there were 384 recorded land claims by white settlers; by 1842 there were more than 2,000. As Indian resistance to the white settlers deteriorated, the U.S. Senate ratified the Treaty of New Echota (1836). In 1838 removal began, a "Trail of Tears," which displaced approximately 2,500 Cherokees from the lower valley of east Tennessee.

Even as General Winfield Scott was executing the Treaty of New Echota by collecting, removing, and marching some 12,000 Cherokees to Oklahoma, whites were rapidly moving into the area. Ross's Landing quickly became Chattanooga in 1838, a trading center which had been described by an English traveler two years earlier as "a small village hastily built, without any regard to order or streets." Hamilton County's white population increased from 821 in 1820 to 2,276 by 1830 and to 8,175 by 1840. By the mid-1840s, the eastern end of the Nickajack Reservoir area had approximately 10,000 residents.

The economy of the region was focused almost totally toward the Tennessee River. The good bottom land and easy access to the river were attractive to many. Marion County developed mainly as an agrarian, rural area with the pioneer families demonstrating self-sufficiency. Corn was the major crop, while hogs and cattle were often the main source of cash income. Tanning yards sprang up, as did grist mills. One of the oldest mills in the area is the Ketner Mill, built in 1824, which served as a focal point in the early settlement of the Sequatchie Valley.

While the western portion of the reservoir area remained rural, Chattanooga at the eastern end became quite urban in the period before the Civil War. In addition to its orientation to the river as a landing point, Chattanooga also became a rail transportation center. By the time the Civil War began, four major rail lines ran through Chattanooga: the East Tennessee and Georgia, the Western and Atlantic, the Nashville and Chattanooga, and the Memphis and Charleston. Chattanooga emerged as a major rail junction and by 1851 was incorporated.

While the benefits of the railroads were numerous, the river was still an important transportation system in the decades before the Civil War. The increase of steamboat traffic brought new people to the area; however, it was still treacherous to travel the river as this description indicates:

It cuts a deep gorge between Raccoon Mountain and the southern end of Walden Ridge about 1,000 feet below their summits. For a distance of about 20 miles, early rivermen knew this section as the Narrows, now called the Grand Canyon of the Tennessee.

Here the river is contracted into a narrow channel bordered by rocky defiles. Fanciful names such as the Tumbling Shoals, the Suck, the Boiling Pot, and the Frying Pan (or the Skillet), were given to the more treacherous places.*

By 1827, there was national interest in improving the Tennessee river for navigation purposes. Secretary of War John C. Calhoun stated that improvement of the Tennessee River was of national concern. Congress even appropriated \$200 for a survey of the Muscle Shoals, Alabama, area in anticipation of building a canal there. However, the canal was not built, nor were any other navigation improvements made to the river because the responsibility of such improvements left the hands of the Federal Government and became the burden of State governments.

For the area that surrounds Nickajack Reservoir, there is a definite turning point in its social history: the Civil War. Like most of east Tennessee, the reservoir area was divided on the issue of secession. At the beginning of the war, many of the men in the valley went east to Chattanooga to enlist in the Confederate Army. Men living in the mountainous areas generally went up the valley to Cumberland County where companies were enlisted in the Union Army.

While Marion County was no major theatre of war, it became a major thoroughfare as Chattanooga became a strategic objective. If the Union Army could take and hold Chattanooga, not only would the railway supplying the Army of Northern Virginia be cut, but also the cotton commerce in northern Alabama and northern Georgia would be disrupted.

In September 1863, General Braxton Bragg defeated Union General Rosencrans at the Battle of Chickamauga. There continued a series of extremely bloody battles for control of the city at Lookout Mountain and Missionary Ridge, which ultimately wound up in Federal hands. The

*Haden, J. Alldredge, et al. A History of Navigation of the Tennessee River System: An Interpretation of the Economic Influences of this River System in the Tennessee Valley. (Washington, 75th Congress 1st Sess., H. Doc. 254., 1937), p. 5.

Army of Northern Virginia was cut off from needed provisions, and the only food source for the men in Chattanooga was Bridgeport, Alabama, also under Union control. From that point on, it was but a matter of time until the rebellion was crushed.

The Civil War had brought tremendous damage throughout the area. Both private and public property were ruined; however, in the reservoir area, Chattanooga was by far the hardest hit. With an 1860 population of 2,545, Chattanooga was almost completely destroyed by the competing armies. The Civil War ended, and Tennessee was readmitted to the Union in 1867. Chattanoogaans were faced with the prospect of rebuilding their town completely--from scratch--but no one doubted that the town would be rebuilt and that it would become one of the important cities of the New South. In fact, city promoters, aware of the available natural resources and the potential money to be made, actually invited northern investors to Chattanooga. The railroad connections, once rebuilt, were excellent. Coal, iron, and timber were nearby. A labor force, white and black, was already pouring into the town in search of opportunities.

The influx of northern capital caused the town to grow with incredible speed. Manufacturing was big business. In 1860 Chattanooga had 22 manufacturing establishments; by 1880 the number had risen to 58. Along the rail lines, industries were springing up, many of them linked to the region's iron ore and coal deposits.

At the other end of the reservoir area in Marion County, industrial development also moved at a rapid pace. Before the war, a geological survey confirmed that there were significant coal and iron deposits in the mountains of Marion County. Around 1870, James Bowron, a noted ironmaster from London, and Thomas Whitwell, a Welsh metallurgist, worked together to form a syndicate known as the Old English Company. In 1873, the syndicate purchased 3,000 acres extending from the Tennessee River to the Cumberland Plateau. The area was to become the town of South Pittsburg.

F. P. Clute, an English engineer, was employed to survey and plan the physical structure of the town. The total enterprise comprised not only the founding of South Pittsburg but also the associated towns of Whitwell and Victoria. The undertaking had projected plans of mining the rich coal seams of the Cumberland Plateau at Whitwell and establishing coke-oven production at Victoria, to supply fuel to fire the blast furnaces at South Pittsburg.

Unfortunately, Bowron died in 1877. His death was followed in 1878 by that of Thomas Whitwell, president of the Old English Company, who was killed in a mine explosion. By strange coincidence, two of the largest stockholders of the syndicate also died within the same 2-year period. The syndicate was left without a guiding spirit and with its future uncertain--the prestigious undertaking had come to an anticlimactic end.

The industrial potential of Marion County, however, continued to attract outside investors. In the late 1880s, the Perry Stove Company of Albany, New York, relocated to South Pittsburg and was soon followed by the Sad Iron Foundry, the South Pittsburg Pipe Company, the South Pittsburg Brick and Terra Cotta Company, the Sequatchie Hoe and Tool Works, and an Eagle Pencil Factory.

Also in the late 1880s, H. I. Kimball developed his Kimball Town Community between Jasper and South Pittsburg. The major industry in this region was the Kimball Knitting Mills. The Sequatchie Town and Improvement Company, established by Glancy Sherman, was responsible for developing the town of Sequatchie between Victoria and Jasper. Improvements to the town included a modern water system and an axe handle factory.

By the end of the 19th century, Marion County was firmly established as an industrial area. A network of railroad lines connected the various places within the county with the coal fields. Industry continued to move into the area: Battle Creek Coal and Iron Company developed mines in the southwestern mountains and developed the town of Orme; the Durham Coal and Iron Company built the company town of "Shake-Rag" near the Tennessee River Gorge; the Tennessee Coke, Iron and Railroad Company established a steam-generating plant at Whitwell; Richard City, home of the Penn-Dixie plant flourished, building worker's housing, a hotel, a school, in fact, the entire city out of concrete. Little remains of this industrial image, yet the stone foundations and ruins of the entire company town of Shake-Rag still stand as a ghostly monument to that era of rapid industrialization in the reservoir area.

In 1904 Congressman John A. Moon introduced a bill that provided for the construction of a dual-purpose dam at Hales Bar. The construction cost was to be the burden of the recipient of the power franchise, which was to run for 99 years. Only the lock gates and machinery were to be provided by the Federal Government. The Chattanooga and Tennessee River Power Company agreed to build the dam, which, when completed in 1913, was known as Hales Bar Lock and Dam.

After the creation of the Tennessee Valley Authority (TVA) in 1933, construction of a series of dams on the Tennessee River provided a stairway of lakes and locks for river tows to travel the full length of the river from Paducah, Kentucky, to Knoxville, Tennessee. High dams on upstream tributary rivers provided storage capacity to prevent the winter floods that had damaged Chattanooga repeatedly.

TVA's development plan incorporated the existing Hales Bar Dam in the chain of main river projects. In the 1960s, however, the old dam was abandoned in favor of Nickajack Dam, constructed between 1964 and 1967 and located 6-1/2 miles downstream. Several factors led to the construction of Nickajack Dam, among them the long history of leakage through the limestone upon which Hales Bar Dam was built, small and inefficient generating units, and limited lock capacity. Thus, Hales Bar Dam was removed and all that remains is the powerhouse.

Until the Great Depression, both Hamilton and Marion County flourished. While the decade of the 1930s hurt Chattanooga, it did not kill it. However, the Great Depression exacted its toll on Marion County as many of the industries and coal mines were abandoned. Even the agrarian lifestyle declined. Today, most of the population of Marion County is concentrated in Jasper, South Pittsburg, and Whitwell.

Chattanooga, on the other end of the reservoir, has bounced back from the economic problems of the 1930s and remains a very commercial, New South city.

ECONOMIC DEVELOPMENT

Transportation

Nickajack Dam, located in the central part of the southern half of Marion County, is roughly equidistant from four major metropolitan areas: Nashville, Knoxville, Atlanta, and Birmingham. Interstate 24 runs through Marion County, connecting in Chattanooga with I-59 and I-75 and in Nashville with I-65 and I-40. U.S. Highways 72 and 127 provide highway connections to the southwest and northeast.

The Tennessee River is part of the interconnected inland waterway system which provides both Hamilton and Marion Counties, industries access to the Port of New Orleans via the Mississippi River and the Port of Mobile via the Tennessee-Tombigbee Waterway.

CSX Transportation has main line rail trackage through the county with direct connections to Chattanooga, Nashville, and the entire Southeast. Other areas of the county are served by the Sequatchie Valley Branch Line Railroad, which connects with the CSX Transportation main line.

Marion County has a lighted, paved airport with a 3,500-foot runway and is 30 miles from Chattanooga's Lovell Field, which is served by Delta, Piedmont, Republic, Tennessee, and Eastern Metro Express airlines.

Industrial Development

The eastern, upstream portion of Nickajack Reservoir is located in and immediately adjacent to the Chattanooga-Hamilton County metropolitan area which serves as the industrial and service center of southeast Tennessee.

Industrial development activities related to Nickajack Reservoir are varied. The upper portion of the reservoir at Chattanooga has the fifth largest concentration of cumulative private investment of 12 areas of major industrial development along the Tennessee River. The central portion of the reservoir has not developed industrially because it is characterized by steep topography. However, along the lower portion of the reservoir, lands near the dam have suitable topography for industrial development activities.

Waterfront industrial development has occurred downstream from Nickajack Dam along Guntersville Reservoir, and non-waterfront industrial development has taken place on industrial sites and in industrial parks along the main highways and railroads within Marion County.

There are three main areas of manufacturing development in Marion County. The city of South Pittsburg is located in the southern portion of the county, along Guntersville Reservoir near I-24, and is 32 miles west of Chattanooga. South Pittsburg is the location of Lodge Manufacturing Company, Salem Carpet Mills, Pittsburg Knitting Mills, Galaxy Mills, Sequatchie Concrete Company, Space Age Manufacturing Company, Sewanee Forest Industries, and Fulton Apparel.

A bridge across the Tennessee River at South Pittsburg provides access to a 100-acre tract of former Nickajack Reservoir land now owned by the Nickajack Port Authority which is available for industrial use. The port authority has developed a barge terminal facility but no other industrial development has occurred.

The town of Jasper, the county seat, is in the central portion of the county, north of I-24, and is 27 miles west of Chattanooga. Jasper is the location of Polymer, Tennessee Consolidated Coal Company, Tokheim Corporation, Rivoli Mills, Coca-Cola Bottling Company, and Cardox Corporation. Tennol Energy Company, which closed in 1988, was a fuel ethanol plant located along I-24 downstream from Nickajack Dam. This plant was the largest single industrial investment in Tennessee in 1984 and had a barge terminal facility on Gunter'sville Reservoir.

The city of Whitwell is located along State Route 28 in the northern part of Marion County in the heart of the coal fields and is 24 miles from Chattanooga. Whitwell is the site of Whitwell Sportswear Company, Sequatchie Handleworks Company, and J&J Apparel Company.

Other industries located in Marion County are Serodino, Inc., and Vulcan Materials Company. Following is a list of industries in Marion County, their product, and employment as of April 1988:

<u>Firm Name</u>	<u>Product</u>	<u>Employment</u>
Cardox Corporation	Industrial Gas	2
Coca-Cola Bottling Company	Soft Drinks	18
Fulton Apparel	Knit Shirts	92
Galaxy Mills	Yarn	215
J&J Apparel Company	Sportswear	70
Lodge Manufacturing Company	Iron Castings	200
Pittsburg Knitting Mills	Hosiery	225
Polymer	Custom Compounding	33
Rivoli Mills	Yarn	65
Salem Carpet Mills	Yarn	276
Sequatchie Concrete Company	Concrete	35
Sequatchie Handleworks	Wood Handles	75

<u>Firm Name</u>	<u>Product</u>	<u>Employment</u>
Serodino, Inc.	Shipyard	20
Sewanee Forest Products, Inc.	Cut Hardwoods	20
Space Age Manufacturing Company	Fireworks	25
Tennessee Consolidated Coal Company	Coal	51
Tokheim Corporation	Hose Reels and Fuel Pumps	70
Whitwell Sportswear Company	Sportswear	105
Vulcan Materials Company	Stone Quarrying	20

This list represents 1,543 jobs in manufacturing and 95 in mining in Marion County. Coal mining activities by Tennessee Consolidated Coal Company have taken a sharp decline since June 1987. It was once the largest employer in the county, with 550 jobs, but employment dropped to 65 when the company shut down its underground mining operations.

Nickajack Reservoir is industrially significant when compared to other TVA reservoirs because of the amount of private investment at Chattanooga. However, there has been limited investment during the past 15 years because of several factors, including the lack of suitable land for development in the vicinity of Chattanooga. Currently, a new port facility, with associated land for waterfront industrial development, is under construction along Amnicola Highway in Chattanooga; when this land is available for development, there should be an increase in waterfront private investment as well as in barge traffic.

Nickajack Reservoir is important on a State, regional, and national level. The waterfront manufacturing that this reservoir provides gives employment opportunities for the fourth largest metropolitan area in the state and for people in northeast Alabama and northwest Georgia.

Navigation Development

Of the 24 barge terminal facilities on Nickajack, half are located in the Chattanooga waterfront area. All but one of the facilities are privately owned, and 19 exclusively serve the industries that own them. The remaining five facilities are available for public use and serve the transportation needs of surrounding industries. The only publicly owned facility is the Nickajack Port, located just below Nickajack Dam. The terminals have a wide variety of handling capabilities and storage facilities but are primarily intended for transfer of liquid and dry bulk commodities. Main commodity groups handled are grain and grain products; stone, sand, and gravel; coal and petroleum products; and iron and steel.

In 1985, when data were last collected, a record 35 million tons of cargo moved on the Tennessee River system. A total of 6.7 million tons (19 percent) moved through Nickajack Lock, an increase of 40 percent over the 1976 total of 4.8 million tons.

In 1985, the three major product groups moving on Nickajack Reservoir were grain and grain products (1,775,729 tons); coal and coke (1,630,731 tons); and stone, sand, and gravel (1,349,613 tons). Totals for other product groups were forest products (403,280 tons), petroleum products (397,459 tons), chemicals (197,514 tons), and iron and steel (136,645 tons). In addition, 795,074 tons of nonclassified traffic moved on the reservoir. Of the total 6.7 million tons, 2.2 million tons or 33 percent was inbound to terminals located on the reservoir and 1.7 million tons were shipped out. Through traffic originating or terminating outside Nickajack amounted to 2.1 million tons. Over 700 thousand tons of commodities moved between terminals located on the reservoir.

Nickajack currently carries a high volume of both local and through waterborne commerce. This intensive use creates a high demand for terminal and barge-related activities such as marine repair and construction, fleetings, and related services. Future developments which can add significantly to traffic on Nickajack include the enlargement of locks above it (Chickamauga, Watts Bar, and Fort Loudoun), industrial development in the upper Tennessee area, and the opening of new markets for east Tennessee products going by way of the Tennessee-Tombigbee Waterway. Current projections are that traffic through Nickajack Lock will increase to over 8.5 million tons in the year 2005.

During the construction of Nickajack Dam, TVA graded and riprapped the underwater portion of the shoreline at two sites, Ladds, Tennessee River Mile (TRM) 429, and Haletown, TRM 430, for the development of barge terminal facilities. An industrial easement for a portion of the land at Haletown was sold to Serodino, Inc., a barge building facility. Serodino was located along the banks of Gunter'sville Reservoir before construction was started on Nickajack Dam and relocated to the Haletown site a few months before the reservoir was impounded. No development has occurred on the remainder of the Haletown site or at the Ladds site, where the backlying land is in private ownership.

Power Generation

Nickajack Dam has four hydroelectric units with a total installed generating capacity of 100,350 kilowatts. It replaced the old Hales Bar Dam acquired by TVA when it bought the Tennessee Electric Power Company in 1940. The Hales Bar Dam spillway section was later removed.

Further upstream at TRM 445 is TVA's Raccoon Mountain Pumped Storage Project, which was completed in 1978. It has the largest pump turbines in the world. The four units have a total generating capacity of 1,530,000 kilowatts. The Raccoon Mountain Project pumps water from Nickajack Reservoir to a 528-acre reservoir on top of Raccoon Mountain during periods of low power demand. The water is then stored in the upper reservoir until it is needed to generate power. During periods of high power demand the stored water is released through turbines back into Nickajack Reservoir to generate electricity.

ENVIRONMENTAL QUALITY

Air Quality

Tennessee has adopted the National Ambient Air Quality Standards, which limit concentrations in the outside air of six pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. These standards are designed to protect public health and welfare. Tennessee has also established ambient standards for gaseous fluorides.

An area where any air quality standard is violated is designated as a nonattainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled.

On November 19, 1989, Hamilton County was redesignated from nonattainment to attainment for ozone. On July 1, 1987, the standards for total suspended particulates were replaced with the PM₁₀ standard for respirable particulates. Prior to that date, the Chattanooga Metropolitan Area was designated as nonattainment of the secondary standard for total suspended particulates. However, EPA considers the area in compliance with the PM₁₀ standard. There are no other nonattainment conditions in the reservoir area.

Tennessee has also adopted Prevention of Significant Deterioration (PSD) Regulations. Under these regulations, national parks and wilderness areas are designated Class I air quality areas, which are specially protected. A new or expanding major air pollutant source within 50 kilometers (km) of a Class I area would be required to estimate potential impact on the air quality of that Class I area.

In addition, the Federal land management agency having jurisdiction over Class I areas may request similar action for large sources at distances of 50 to 100 km. The only Class I area within 100 km is the Cohutta National Wilderness Area, which is about 70 km east of the upper end and about 90 km east of the lower end of Nickajack Reservoir.

Visual Quality

Nickajack Reservoir's visual resources provide a wide variety of landscapes. They vary from the riverine tailwater below Chickamauga Dam through downtown Chattanooga and the Tennessee River Gorge to an open lake expanse above Nickajack Dam. Over two-thirds of the reservoir is riverine in appearance. As the Tennessee River passes through downtown Chattanooga, numerous industries, barge terminals, utility crossings, and outfall pipes are the dominant visual features. Views of the waterway are of greater value to the land-based observer than are views of the shoreline economic development activities as seen by the passing boater.

Lookout Mountain on the left bank and Signal Mountain on the right bank mark a notable change in scenic resources passing downstream from Chattanooga. Signal Mountain marks the entrance to "The Grand Canyon of the Tennessee River." The steep and wooded left bank of the reservoir is countered on the right bank by a 5- to 6-mile stretch of shoreline dotted with primary and secondary residences, shacks, condominium developments, junk cars, and occasional commercial operations.

Moving downstream, the gorge's high bluff-like walls tower upward more than 1,000 feet from the shoreline, affording spectacular views from overlooks on Raccoon Mountain and various points in Prentice Cooper State Forest. Two cove-like embayments, Cummings Lake and Mullins Cove, are adjacent to the riverway as it passes through the gorge. The scenic, pastoral settings adjacent to these embayments are visible to passing boaters. The gorge provides many scenic vistas from adjacent overlooks and roadside pulloffs along the riverway and provides the Nickajack Reservoir area and the entire Tennessee River Valley with a unique scenic resource.

Moving downstream from the gorge past Bennett Lake with its massive quarrying operation, the reservoir takes on an industrial commercial tone. The old Hales Bar Dam Powerhouse protrudes into the reservoir from the left bank and is the location of a commercial marina and campground. Across the reservoir on the right bank is a coal barge loading terminal. Immediately downstream of Hales Bar Marina on the left bank is a barge servicing facility that occupies a fleeting area over half the width of the reservoir. These four operations are the predominant visual features in the landscape as seen by motorists looking upstream from the U.S. Highway 41, 64, and 72 bridge and those crossing the reservoir on Interstate 24.

Views downstream from the Interstate 24 crossing and rest area have a higher aesthetic quality. The reservoir widens at this point, taking on a more lake-like appearance. The left bank landscape is mountainous in nature, while the northern shoreline has a ridge-like character. Portions of Sand Mountain forming the reservoir's southern shoreline are interrupted with numerous powerline cuts, railroad cuts and fills, and a varied assortment of developments along State Highway 156.

Of greatest scenic value in this area of the reservoir is Nickajack Cave. Little Cedar Mountain, located on the right bank of the reservoir, is a composite of landscapes ranging from relatively level agricultural fields skirting much of the shoreline to one dominant ridge area with a scenic bluff dropping into the lake at its southernmost tip.

Water Quality

The State of Tennessee classifies streams and rivers for seven uses: domestic water supply, industrial water supply, fish and aquatic life, recreation, irrigation, livestock watering and wildlife, and navigation. The Tennessee River through Nickajack Reservoir is classified acceptable for all seven uses except for the reach between TRM 448 and 460. This reach is classified acceptable for all uses except domestic water supply and recreation.

The three major factors affecting water quality in Nickajack Reservoir are: (1) most of the water inflow to the reservoir is from Chickamauga Reservoir, (2) the residence time of water in the reservoir is short, and (3) municipal and industrial wastewater and runoff from the Chattanooga metropolitan area enter at the reservoir's upper end. The primary water quality concerns are (1) impacts on aquatic life of low dissolved oxygen (DO), (2) impacts on recreation as a result of excessive growth of algae and aquatic weeds and potential impacts of these on future water supplies in the lower reach of the reservoir, (3) impacts on recreation because of bacterial contamination, (4) impacts on aquatic life from toxic materials, and (5) impacts on aesthetics resulting from high color of wastewater discharge.

Dissolved Oxygen - Because more than 95 percent of the inflow is released through Chickamauga Dam, those releases are critical to the water quality of Nickajack Reservoir. TVA maintains a 6,000-cubic-foot-per-second (cfs) minimum average daily flow from Chickamauga Dam to maintain water quality in Nickajack Reservoir. A DO concentration of 5 milligrams per liter (mg/L) is required to protect aquatic life in the reservoir. While DO seldom drops below 5 mg/L in the releases from Chickamauga, except during periods of very low flow, summer DO is seldom much above 5 mg/L either. Recent analyses indicate that for flows of 6,000 to 8,000 cfs, DO in the river downstream of the Moccasin Bend discharge is about 1 mg/L less than in the releases from Chickamauga Dam. Therefore, summer DO concentrations in parts of the river may be below the State standard of 5 mg/L during low flow periods. This limited assimilative capacity will be a major factor to consider in planning for Chattanooga's future growth.

The average residence time (approximately three days) of water in Nickajack Reservoir is a major factor in preventing low DO from occurring except in some of the tributary embayments and shallow overbank areas. The residence time in these protected areas is longer because of the slow exchange rate with waters in the main channel. Even when DO in the river below the Moccasin Bend discharge is below 5 mg/L, sufficient reoxygenation occurs before the water reaches Nickajack Dam to keep DO in the releases from Nickajack Dam above 5 mg/L almost all the time.

Algae and Aquatic Weeds - Nearly all the nutrients in Nickajack Reservoir enter at Chattanooga, primarily in the inflow from Chickamauga Dam or from local sewage treatment systems. Nutrients are necessary for the growth of algae and aquatic plants. Algae form the base of the food chain in reservoirs, and in general luxuriant growth is associated with larger standing crops of fish and other aquatic life. However, excessive growth will produce nuisance problems affecting recreation, aquatic life, and water supplies. Nickajack does not have algal problems, in part because of the shape of the reservoir and the high velocity of the water flowing through it. A study in 1980 indicated, however, that excessive growth of the noxious blue-green algae could occur if there were a significant increase in nutrients.

Of TVA reservoirs, Nickajack has the third largest percentage of its surface area infested with aquatic weeds--14 percent or 1,400 acres. This is an increase from 11 percent in the early 1980s and probably reflects the more favorable growing conditions during the recent drought. Enrichment of areas such as the relatively shallow overbanks and protected embayments in the lower end of the reservoir by local sources, through development without consideration for waste disposal, could encourage additional algal and weed growth.

Bacterial Contamination - Another impact of Chattanooga on Nickajack's water quality comes from high bacteria concentrations from sewage system bypasses and combined sewer overflows. From a historic perspective, discharges from the city of Chattanooga, industries, and other communities discharging to tributary streams such as Chattanooga Creek (TRM 460.6) and South Chickamauga Creek (TRM 468.2) have affected water quality conditions in Nickajack Reservoir, and formerly Hales Bar Reservoir, since the founding of TVA. TVA's first assessment of water quality of the Tennessee River system identified extensive bacteria contamination of Hales Bar Reservoir at Chattanooga in 1937.

The older downtown portion of Chattanooga is served by a combined sewer collection system. This type of system was used around the turn of the century to convey a combination of sanitary sewage and stormwater runoff. In rainy weather the storm flows exceed the capacity of the sewer lines and they overflow, delivering the untreated sewage and storm water to the river. Along the bank of the Tennessee River from Citico Creek (TRM 465.2) to Chattanooga Creek (TRM 460.6) there are 15 combined sewer outfalls which may overflow to the river. Also, the main bypasses for the Moccasin Bend Treatment Plant and the Mountain Creek Pump Station may discharge in the event of major pump failure or unusual system overload. Twenty-four other relief points in the city's system may discharge to tributary streams during heavy rainfall. After a heavy rainfall the combined sewer overflow causes an increase in bacteria and nutrient levels and a decrease in dissolved oxygen concentrations because of large oxygen demand. The extent and duration of these water quality impacts are directly related to the intensity and duration of the rainfall event and antecedent rainfall conditions. However, most of the time they are of short duration.

Bacteriological conditions in Nickajack Reservoir have improved greatly as wastewater treatment at Chattanooga has improved and industries have removed their discharges from tributary streams and connected to the regional treatment facility at Moccasin Bend. The last and most extensive upgrading of this treatment facility was completed in 1984 and was designed to handle wastewater from the Chattanooga metropolitan area to the year 2004. During the 1982-84 plant expansion, required bypasses caused bacteria concentrations to exceed recreation criteria as far downstream as Nickajack Dam. However, since its expansion, the plant has consistently met the requirements of its discharge permit. Water quality criteria for recreation are frequently exceeded downstream of the Moccasin Bend sewage treatment plant. However, Tennessee does not consider the stream reach immediately below a sewage discharge suitable for recreation use, which is why the reach between TRM 448 and 460 is not classified for recreation.

Toxic Materials - Across the Tennessee River from the Moccasin Bend sewage treatment plant is Chattanooga Creek. Past industrial discharges have resulted in high concentrations of many toxic materials in the stream sediment and concentrations of six toxic materials in the water that exceed standards for either aquatic life or human consumption. Although the stream is posted to warn against any contact, studies indicate that the toxics in the stream do not pose a threat to the Tennessee River.

Aesthetics - The outfall for the Moccasin Bend wastewater treatment plant is located at Tennessee River mile 457.8, just downstream of Moccasin Bend. Over half the wastewater treated at the facility comes from industries, some with highly colored waste. The treatment provided does not remove this color; therefore, the wastewater is highly visible as it is discharged into the Tennessee River at mid-channel. The aesthetically objectionable condition caused by the outfall extends for about 2 to 3 miles to and alongside Williams Island. The increased recreational use of the river, coupled with the public's increased environmental awareness, has resulted in numerous complaints about the colored effluent. The Tennessee Department of Health and Environment has requested the city to investigate and to correct the situation.

RECREATION

TVA recognized in the early sixties that the Nickajack project would affect local governments and initiated a series of meetings in Marion County to discuss planning for area development. As a result, the Marion County Planning Commission was organized and, along with the Tennessee State Planning Commission, prepared "A Plan for Development, Nickajack Reservoir Area" in 1965 to guide recreation development and other land uses on the reservoir. Existing recreation development such as Marion County Park, Hales Bar Marina, and Running Water Campground resulted from recommendations presented in the land use plan. The plan also identified a 600-acre portion of TVA's Little Cedar Mountain property as a major recreation development site because (1) regional access via I-24 and US 41/64/72 was excellent, and (2) the site represented the only suitable location for intensive recreation development on the reservoir. The Tennessee Department of Conservation (TDOC) completed a master plan for a State resort park on Little Cedar Mountain in June 1973. The poor economy of the seventies and changes in TDOC policy prevented subsequent efforts to get the park development off the ground.

While the high recreation potential of Nickajack Reservoir was recognized in the earliest planning for the project, it was also recognized that the full recreation potential of the new reservoir would not be realized unless conditions contributing to pollution, which was a matter of record on Hales Bar Reservoir, were corrected. With the improvement of Chattanooga's sewage treatment facility at Moccasin Bend in the late sixties and early eighties, water quality problems related to water-contact recreation activities were virtually eliminated in the lower third of the reservoir.

In 1980, when data were last collected, recreation development on Nickajack Reservoir was valued at \$4 million--the lowest of TVA's mainstream reservoirs. There were 600,000 annual recreation visits to the reservoir. The annual Fall Color Cruise, the major recreation event on the reservoir, attracts 80,000 to 100,000 visitors for special events to TVA's Shellmound Recreation Area during a two-week period in October. Existing recreation development on Nickajack Reservoir includes:

Upper third of the reservoir

- Two city parks
- Four golf courses
- One commercial recreation area
- Two TVA recreation areas
- Three boat launching ramps
- One national military park

Middle third of the reservoir

- Two commercial recreation areas
- Three boat launching ramps
- Two TVA recreation areas
- One State forest and wildlife management area
- One national military park

Lower third of the reservoir

- Two commercial recreation areas
- Two county parks
- Nine boat launching ramps
- Two interstate rest areas
- Five TVA recreation areas

Commercial Recreation

Commercial recreation development on Nickajack Reservoir is limited to one full-service marina, one small marina, and three commercial docks (typically limited to gas, food, or temporary docking services). Ninety-six slips are available for docking space on the reservoir. Previous water-quality problems undoubtedly hindered development of commercial recreation services and contributed to the lack of other full-service marina developments. At TRM 431, Hales Bar Marina represents the only full-service marina on the mainstream of the Tennessee River from Chickamauga Dam, TRM 471, downriver to Gunter'sville Reservoir at TRM 386.

Natural Areas

Few designated natural areas can be found on Nickajack Reservoir; however, many such areas occur away from the reservoir on the Cumberland escarpment. South Cumberland Recreation Area, including Foster Falls Small Wild Area, Grundy State Forest, Savage Gulf State Natural Area, Fiery Gizzard Trail, Buggy Top Cave, and Sewanee Natural Bridge are perhaps the most significant and well-known.

From TRM 432 to TRM 456, the Tennessee River forms what is referred to as the "Grand Canyon of the Tennessee." Much of the land in this narrow, steep-walled gorge is relatively unspoiled in character and is publicly owned or in large private land holdings (TVA's Raccoon Mountain Pumped-Storage Facility, Prentice-Cooper State Forest and Wildlife Management Area, Hiwassee Land Company, etc.). In 1983, The Nature Conservancy (TNC) began efforts

to protect the scenic beauty of the river gorge. Ecological surveys revealed an array of rare plant and animal species. Twenty specific natural areas were identified through biological inventories. Hicks Gap, which provides habitat for the largest known population of the federally endangered large-flowered skullcap (Scutellaria montana) is now a State-designated Class II natural area on Prentice Cooper State Forest and Wildlife Management Area. TVA also entered into a memorandum of understanding with TNC to protect scenic resources on TVA-managed lands in the gorge, especially those occurring in the area of the Raccoon Mountain Pumped Storage Facility. The Tennessee River Gorge Trust, Inc., was formed in 1986 to further these protection efforts.

The most outstanding geologic feature within the reservoir area is Nickajack Cave. It played a significant role during early settlement and has a long and colorful history. President George Washington once ordered a land survey from "Natchez to Nickajack." An impressive landmark before impoundment, the mouth of the cave was 140 feet wide and 50 feet high. The cave provided refuge for Indians and river pirates who preyed upon travelers on the Tennessee River. It was the focus of a sensational cave rescue attempt and was mined for saltpeter during the Civil War. For a time after the war, it had a dance floor.

"... where it is cool and shady even on the hottest day, the young folks made merry to the tune of the fiddle, or waited out the dances in the cool, dim darkness beyond.*

At this well-known tourist attraction, visitors could take a three-hour boat trip into the cave on the "River of Darkness." A huge flowstone formation within the cave, referred to as "Mr. Big," is 60 feet high and 75 feet in diameter.

Nickajack Reservoir now floods the lower half of the entrance, which was fenced in 1981 to protect populations of federally endangered gray and Indiana bats that use the unflooded portion of the cave. In 1985, the cave was designated by the Tennessee Wildlife Resources Agency (TWRA) as a Wildlife Observation Area. It provides an opportunity for the public to witness the hour-long evening emergence of approximately 125,000 gray bats as they leave the cave to feed on insects over Nickajack Reservoir. Not far from Nickajack Cave, three States, Alabama, Georgia, and Tennessee, come together at a tri-State marker.

Public Recreation

TVA has developed and operates nine recreation areas on Nickajack Reservoir, including facilities on Nickajack and Chickamauga Dam Reservations and at the Raccoon Mountain Pumped-Storage Facility. These include one fee campground, four nonfee recreation areas, one combination fee campground/nonfee recreation area, and three boat launching areas. Facilities vary from site to site but may include boat launching ramps, trails, swimming beaches, camping and picnicking facilities, and restrooms. This development represents an initial investment by TVA of \$315,000 (excluding those at Raccoon Mountain) in recreation facilities on Nickajack Reservoir.

*Few Visitors Have Ventured Far Into Cave," newspaper account, clipping file, historical collection. Chattanooga Public Library.

The National Park Service manages the Chickamauga and Chattanooga National Military Park, the first of four national military parks established between 1890 and 1899. The park contains about 8,000 acres dispersed among six major management areas in the Chattanooga vicinity. Two of these, Lookout Mountain and Signal Point Reservation, contain about 2,800 acres located adjacent to Nickajack Reservoir. An extensive trail network, in addition to picnicking and visitor facilities, is provided. The park is a major attraction for tourists from all over the United States.

Prentice Cooper State Forest and Wildlife Management Area provides 26,000 acres of forested land for a variety of passive outdoor recreation pursuits. This area contains 40 miles of hiking trails which are part of the State-designated Cumberland Trail, two picnic areas, and primitive camping areas. The area is predominantly used by local residents, with increasing use of the area being attributed to rock climbers and off-road vehicle users.

The Tennessee Wildlife Resources Agency developed and maintains the Suck Creek and Bennett Lake water access areas. Facilities include concrete boat ramps and 40- and 20-space parking lots respectively.

There are two county parks, two city parks, and one municipal golf course adjacent to the reservoir. All the municipal facilities are in the Chattanooga area. Marion County manages two parks on TVA land in the lower portion of the reservoir. There are no local recreation facilities developed on the middle portion of the reservoir.

The City of Chattanooga and Hamilton County have taken the lead in promoting and developing a riverfront redevelopment that will extend from Chickamauga Dam 26 miles downstream to the Hamilton/Marion County line. As one component of this project, construction was completed in May 1989 on \$4.3 million in new recreation development along 2 miles just below Chickamauga Dam. The park represents a trend by local governments to develop/manage greenway corridors that are viewed as a dwindling resource vital to future recreation needs.

RESOURCE MANAGEMENT

Agriculture

Agriculture is important in the two-county area around Nickajack Reservoir. In 1982, there were 940 farms in Marion and Hamilton Counties with sales of all farm products totaling \$16.5 million, an increase of \$1.9 million since 1978. Land in farms totaled 233,428 acres, an increase of 10,000 acres over 1978, with the average farm size increasing slightly to 141 acres. Total cropland and harvested cropland increased slightly to 65,408 and 32,915 acres respectively.

The major farm products sold are livestock and poultry. Approximately 20,000 head of cattle and calves are produced in the two-county area. Soybeans are by far the leading crop produced utilizing 13,300 acres. Although the area is insignificant nationally as an agricultural area, the reservoir's close proximity to metropolitan markets like Chattanooga and Knoxville provides good potential for increased high value crops such as fruits and vegetables.

Compared to other TVA reservoirs, Nickajack has very little prime farmland. Concentrations occur on the north bank below Nickajack Dam and in the Little Cedar Mountain area. The total land base available for agriculture in the reservoir area will likely decrease in the next 10 to 20 years as a result of increased pressure for industrial, commercial recreation, and residential development.

Fisheries and Aquatic Ecology

Nickajack Reservoir contains a variety of aquatic habitats. Approximately 75 percent of the reservoir from Tennessee River Mile 436.0 to Chickamauga Dam (TRM 471.0) can be classified as riverine, with a narrow width, fast currents, and relatively little overbank area. Downstream of TRM 436.0, the reservoir becomes lacustrine, as characterized by more numerous embayments and overbank areas, an increase in width, and a reduction in current velocity. Submersed aquatic macrophytes are present throughout the reservoir with increased colonization occurring in the lacustrine region. This variety of habitat supports a diverse fish community with a total of 65 species reported from population studies.

Fisheries cove rotenone data for Nickajack Reservoir is limited to four cove areas which were sampled during 1972 and 1977 to 1981. During 1980, additional areas immediately adjacent to two of the original coves were sampled, giving the equivalent of six sample areas for that year. Population trends observed during the 1977 to 1981 period showed increases in redear sunfish, largemouth bass, and brook silverside. These trends were attributed primarily to the increasing densities of aquatic macrophytes. Since these data represent a relatively short biological time period and fish populations fluctuate in "cyclic" patterns of varying durations, it is not possible to determine the present population status. However, since aquatic plant infestations on Nickajack Reservoir have generally increased since the 1977-1981 period, it is probable that the present fish population continues to be comprised of large numbers of species which favor this type of environment. An examination of the available sport fishing creel information tends to support this hypothesis.

A comparison of creel data collected by TVA (July 1, 1976, through June 30, 1977) with those collected during 1988 by the Tennessee Wildlife Resources Agency indicates an increase in the estimated number of fish species caught. In decreasing order of abundance, fisherman catches in 1988 were comprised of bluegill, largemouth bass, redear sunfish, white bass, channel catfish, spotted bass, black crappie, and blue catfish. The average catch rate during this period was 0.25 fish per hour.

Commercial fishermen tend to work both Nickajack and Chickamauga Reservoirs as a single fishing region. Therefore, the number of commercial fishermen using Nickajack is considered to be the same as that for Chickamauga. At present, Nickajack has about 20 to 25 full-time licensed net fishermen, and 100 trotline and slat basket fishermen. Buffalo harvest has been consistent over the last several years while paddlefish harvest has decreased. The harvest of channel catfish during this period has increased.

Mussels - No extensive survey of mussel resources has been conducted in Nickajack Reservoir. In 1978, TVA biologists made brief, random scuba dives at ten sites between TRM 454.0 and TRM 469.0. The results from those dives suggest the fauna consists of relatively few species and is fairly sparse. There is no known commercial mussel fishery on Nickajack Reservoir.

Mussel resources in the immediate tailwater of Nickajack Dam also have been sampled only briefly. In 1978, TVA biologists examined seven sites between the dam and TRM 417.0. No extensive mussel stocks or particular diversity were encountered. More extensive mussel beds and a limited commercial mussel fishery are found further downstream in Gunterville Reservoir.

The State of Tennessee has established two mollusk sanctuaries in or adjacent to Nickajack Reservoir. One sanctuary extends from TRM 465.9 upstream to Chickamauga Dam. The other runs from the Alabama State line (TRM 416.5) to Nickajack Dam. Collecting mollusks or disturbing mollusk habitat in these sanctuaries without State permission is prohibited.

Threatened and Endangered Species - As indicated previously, the aquatic fauna of Nickajack Reservoir has not been studied extensively. The only aquatic species listed as either endangered or threatened by the U.S. Fish and Wildlife Service and known to occur in Nickajack Reservoir is the snail darter, Percina tanasi. This fish, now on the Federal threatened species list, was thought to survive only in the Hiwassee River until it was discovered in South Chickamauga Creek in 1980. Searching in the adjacent reach of the Tennessee River resulted in the sighting of four individuals near TRM 468.0. Since then, snail darter populations have been found in several Tennessee River tributary streams from the Paint Rock River in Alabama to Sewee Creek near Watts Bar Dam.

In South Chickamauga Creek, snail darters have been observed from the mouth upstream to creek mile 19.0. In 1981, similar investigations located a small snail darter population in the downstream reach of the Sequatchie River (to river mile 17.0) and in the adjacent section of the Tennessee River (the Nickajack Dam tailwater). If these are like other snail darter populations, each year adult fish move up into the smaller stream to spawn. Later in the year, surviving adults and young fish drift down into the Tennessee River as they begin to move

around. Unhampered movement between both habitats appears to be necessary for the continuation of each population. The South Chickamauga Creek population, at least, seems to have been able to tolerate considerable human impact, including sewage outfalls, urban runoff, and some channelization.

Physical/Chemical Influences - Chemical contaminants have been found in catfish collected from Nickajack Reservoir as part of TVA's Valley-wide Fish Tissue Screening Study. Individuals collected during the study showed relatively high levels of polychlorinated biphenyls (PCBs) and chlordane. Additional catfish, largemouth bass, crappie, and smallmouth buffalo were collected in autumn 1988 from several areas of the reservoir to confirm these results.

Results from analyses of these fish were recently provided to State public health experts who are to determine if a fish consumption advisory is warranted. This decision is expected by the end of the 1989 calendar year. In the interim, plans have been made to continue the collection of fish from Nickajack to further define the situation.

Aquatic Plants - From 1980 to 1986 submersed aquatic plant infestations on Nickajack Reservoir have ranged from 1,025 to 1,485 acres. The peak of 1,485 acres, representing about 14 percent of the reservoir's surface area, occurred in 1986. This represents an approximate 300-acre increase from 1985 and corresponds to a general aquatic plant expansion that occurred throughout the TVA reservoir system. During the period from 1980 to 1986, species composition has shifted from a community dominated by Eurasian watermilfoil to a mixed community of Eurasian watermilfoil and spinyleaf naiad. The largest acreages of plants occur from the Mullins Cove area (TRM 437) downstream to Nickajack Dam.

Herbicide treatments are used to control aquatic weeds in areas where they conflict with reservoir use. High priority areas generally include areas around commercial marinas, public use areas, campgrounds and resorts, residences, and industrial raw water intakes, and in areas with dense weed infestations associated with high mosquito production. The majority of the priority treatment areas on Nickajack Reservoir are in the vicinity of Nickajack Dam (TRM 425 to 426), in the area from Interstate 24 upstream to old Hales Bar Dam (TRM 429 to 431), in Bennett's Lake, and from Mullins Cove upstream to TRM 440. In 1987, 262 acres were treated on Nickajack Reservoir to control aquatic plants in priority areas.

In terms of the percentage of infested reservoir surface area, Nickajack Reservoir is exceeded only by Gunter'sville and Chickamauga Reservoirs. However, the acreage requiring herbicide treatment on Nickajack Reservoir in 1987 was significantly less than these two reservoirs and slightly less than Kentucky, Wheeler, and Watts Bar Reservoirs. The size of Nickajack and the small amount of shoreline development largely accounts for its lower treatment requirements. Increased shoreline development for residential, recreational, or industrial purposes will increase treatment acreage requirements.

Aquatic weeds likely will continue to be a problem on Nickajack Reservoir and require maintenance control measures in priority areas. The yearly infestation level will vary with environmental conditions and is expected to range from about 1,100 to 1,500 acres. However, if noxious weed species, such as hydrilla, become established, the magnitude of the weed problem is expected to increase substantially and require greater resource allocations to maintain acceptable levels of control.

Vector Control - Current mosquito production on Nickajack Reservoir that would be of public health concern is limited to the permanent pool types (Anopheles quadrimaculatus, An. punctipennis, and Culex erraticus) and is associated with the amounts and types of aquatic vegetation present. Submersed aquatic vegetation is the dominant type associated with mosquito breeding on Nickajack Reservoir and, of this, Eurasian watermilfoil provides the best habitat. Mosquito populations will fluctuate with changes in the amount and types of submersed aquatic vegetation. General increases in infestation levels over the past ten years have resulted in accompanying increases in mosquito populations and the need for chemical treatments.

The need for chemical treatments for control of mosquitoes can also be expected to increase as development and utilization of reservoir shoreline areas increases, potentially exposing more people to mosquito bites. Chemical treatments at present are limited to five or six priority areas which are monitored weekly to determine when treatments are required.

Of the mainstream TVA reservoirs on which mosquito control operations are conducted, Nickajack ranks about sixth out of a group of eight in severity of mosquito problems. Despite this relatively low ranking among TVA reservoirs, Nickajack has significant mosquito problems when compared nationally with other freshwater impoundments. Most of the problem areas are located in the lower one-half of the reservoir and do not become a major concern until about mid-summer when submersed aquatic vegetation reaches the surface. Prior to this time, the 1-foot weekly fluctuation of lake levels is effective in controlling mosquito breeding.

Archaeology/Historic Architecture

Archaeology - The 1,000-acre lower portion of Moccasin Bend was designated a National Historic Landmark in 1986 largely through the efforts of the Chattanooga Regional Anthropological Association (CRAA), a local nonprofit organization. This acreage, scheduled to be developed as a cultural heritage park, contains 20 major archaeological sites which encompass human occupation of the Valley over the past 11,000 to 12,000 years.

Williams Island adjoins Moccasin Bend and contains 30 archaeological sites. In 1989, in a collaborative effort by CRAA and the Tennessee River Gorge Trust, Inc. (Trust), another local nonprofit organization, the State of Tennessee purchased Williams Island as a State archaeological preserve for prehistoric, historic, and natural resources. The island will be managed locally in a private/public partnership by CRAA and the Trust.

CRAA also donated efforts to delineate, interpret, and stabilize the Harwood Gulf archaeological site. In 1988 and 1989 the Trust purchased the 600-acre Grant property which adjoins the Harwood Gulf site. This area of the gorge will be used for natural and cultural education activities.

During September and October 1987, an archaeological survey of all plan lands was conducted. Fifty-six sites were found which exhibited material remains from human activity, either during prehistoric or historic times. Nine of these sites had been previously recorded and were relocated and investigated. Of the 56 sites, 28 are prehistoric, which provides mute testimony to use of this area for about 12,000 years prior to the influx of settlers in the early 1800s. Prehistoric sites located in the survey area date from nearly the earliest known period of human habitation in the Tennessee Valley to and into Mississippian times, the latest period

of prehistoric use of the area. The survey also located 28 historic sites, of which seven are cemeteries with marked graves and one is a standing structure. As with the prehistoric sites, these historic resources are representative of several temporal periods with one grave marked with the early burial date of 1820.

Several of the 56 sites are important because of their potential to provide new or additional data on the prehistory of the local area and the region. As such, these sites are possibly eligible for inclusion in the National Register of Historic Places.

Historic Architecture - There are relatively few historic sites (over 50 years old) or significant structures in the Nickajack Reservoir area as compared to other TVA reservoir areas. This is due in large part to the geographic restrictions of the Tennessee River Gorge, and to reductions in the habitable land base first in 1913 with the construction of Hales Bar Dam and then again in 1967 with the construction of Nickajack Dam. These two projects had major impacts on the reservoir area, altering and eliminating many earlier historic features. The few remaining significant features consist primarily of log houses, farm buildings, and early cemeteries.

Forestry

Of the plan lands inspected, the forest cover types and the percentage of the total they comprise are: hardwood, 35 percent; pine, 10 percent; mixed (hardwood-red cedar, hardwood-pine), 40 percent; and scrub/shrub, 15 percent. Generally, upland hardwood and mixed stands are found on the steep to moderately steep slopes, while most of the pine stands are located on areas with rolling to flat topography. Bottomland hardwood stands are limited to a few areas along the reservoir and lowland drainages.

Agricultural land use has removed forest cover from some reservoir properties; however, several old fields have been planted to loblolly pine and now represent a desirable forest situation. From a commercial forestry standpoint, most abandoned fields have reverted to undesirable and unproductive cover. In addition, construction activities below Nickajack Dam have left an area of approximately 125 acres covered with rocky, compacted soil that severely restricts establishment of a productive forest resource.

From a commercial timber standpoint, most of the forest cover is young or intermediate in age. The average stand age is 50 years (3-100), with the pine stands averaging 30 years and the hardwood 70 years.

The most productive areas from a forestry perspective are some of the upland hardwood stands, which occur on deep, moist soils. Species which characterize these stands are northern red oak, white oak, and yellow poplar. Other excellent forestry areas include approximately 165 acres of planted loblolly pine located along Shellmound Road on the north side of the reservoir.

Areas of lower forestry potential, with less desirable species composition and quality, are usually found on sites with low to moderately productive soils. Most of these stands are mixed upland hardwood-pine and usually occur on the south to southeast facing slopes. Species characteristic of these sites are southern red oak, black oak, hickory, shortleaf pine, and Virginia pine.

Several small bottomland hardwood stands are located on areas of good site quality, but the species present (red maple, sycamore, cottonwood, and sweetgum) are not as desirable as the upland oaks and pine. Portions of these stands also have severe competition from uncontrolled honeysuckle, privet, and multiflora rose.

A significant portion of the forested lands has little or no commercial forestry potential. The largest portion comprises upland hardwood-red cedar stands on poor sites with exposed limestone rocks and shallow, poor soils. These poor quality stands are a direct result of the karst topography which is common in this area of the Tennessee Valley along the Cumberland escarpment. Typical species present are red cedar, post oak, and scarlet oak.

Markets for most wood resources are present in the Nickajack area. Pine sawtimber is generally the most valuable timber resource; however, high-quality hardwood can exceed pine values. Hardwood sawtimber is primarily used for rough lumber, crossties, and tool handles; and pine is primarily used for finished lumber. Also, there are markets for both pine and hardwood pulpwood in the area. Another component, red cedar, which is prevalent on many areas of the reservoir, is also in demand.

Although from a forestry perspective Nickajack Reservoir lands are not significant when compared with other mainstream reservoirs, there is still potential for forest management on many areas. There are tracts that present excellent opportunity for hardwood management, and the pine plantations represent a forest management and financial opportunity. Opportunities also exist for future forest management on Nickajack in pine and/or hardwood planting on agricultural lands not under license and open areas. These fields have highly productive soils and, if not maintained or planted, they will probably revert naturally to commercially undesirable tree species such as sweetgum, elm, and Virginia pine.

A six-county TVA survey of wood-using industries conducted in 1982 showed limited potential for expanded forest utilization operations in the Nickajack Reservoir area. The survey concluded that past forest management practices have left much of the private forest in a poor condition with limited value. Because of these circumstances, future forestry and related operations are likely to remain at about their present levels in the reservoir area.

Threatened/Endangered Species

Several animal species listed by the U.S. Fish and Wildlife Service or the State of Tennessee as endangered, threatened, in need of management, or candidate species for Federal listing occur or have been reported in the Nickajack Reservoir study area. The gray bat (Myotis grisescens) and Indiana bat (Myotis sodalis), both federally listed endangered species, are inhabitants of caves along the reservoir. Recent censuses indicate a population of approximately 125,000 gray bats use Nickajack Cave for rearing young during the summer. This is a large increase over population levels of 10 to 15 years ago. At that time, it was possible to approach the bat roost in the cave by boat, and frequent human disturbance reduced the bat population. In 1981, TVA installed a fence across the mouth of Nickajack Cave to restrict human access, and the bat population increased significantly. Gray bats historically hibernated in Nickajack Cave, but there is no recent information on the winter bat population. The Indiana bat lives outside caves during the warm months and uses them for hibernation. Indiana bats have been

reported from Nickajack Cave, but there is no information available on current use of the cave. The eastern small-footed bat (Myotis leibii) was found in Nickajack Cave in 1950. This species is listed as in need of management in Tennessee and as a candidate species for Federal listing. The current status of this species in the Nickajack Reservoir area is unknown.

Small numbers of bald eagles (Haliaeetus leucocephalus), a federally endangered species, can be found along Nickajack Reservoir during the winter, and occasionally at other times of the year. Larger numbers, up to 10 or more, frequent TVA's Raccoon Mountain Pumped-Storage Reservoir. Bald eagles were reported to have nested in the Cummings Lake area in 1983. Between 1979 and 1985 Nickajack Reservoir accounted for 9 percent of all bald eagles counted in eastern Tennessee and ranks fourth in the number of wintering bald eagles behind Watts Bar, Norris, and Chickamauga Reservoirs. Wintering bald eagle numbers will be adversely impacted by continued development of the reservoir shoreline. The maintenance of shoreline areas isolated from urban-industrial complexes is requisite to maintaining suitable densities of wintering bald eagle populations.

Osprey (Pandion Haliaeetus) historically nested along the major river systems of the Tennessee Valley, although probably not in any great numbers. Listed as endangered by the State of Tennessee, osprey are fairly common on Nickajack Reservoir with the majority of birds present during the spring and fall migrations. Biweekly aerial surveys conducted in 1979 recorded a total of 14 osprey on Nickajack Reservoir between April and September. A total of eight young osprey have been hacked by TWRA during 1980, 1981, 1982, and 1983 (two birds per year) from the Cummings Lake (TRM 442.4) area. Hacking is a technique used to rear and reintroduce raptors to historic nesting areas. A natural osprey nest with two young, located across the reservoir from Cummings Lake, was reported during the spring of 1986. The presence of osprey on Nickajack Reservoir is of both regional and local significance because of the birds' special status in Tennessee. Surviving osprey from the Nickajack hacking project should begin returning to the reservoir to nest in the next few years. These birds, along with expanding regional osprey populations, should allow numbers of osprey using Nickajack to increase during the next 10 years.

The double-crested cormorant (Phalacrocorax auritus) is listed as in need of management by the State. Although the cormorant does not breed in the Nickajack Reservoir area, small numbers occur along the reservoir from fall through spring.

The red-shouldered hawk (Buteo lineatus), listed as in need of management by the State of Tennessee, is an uncommon year-round resident in the Nickajack Reservoir area. Two active red-shouldered hawk nests were found in the area in 1983. Once established, the pair usually returns to the same territory year after year. The red-shouldered hawk population in the reservoir area and surrounding region should remain stable over the next 10 years if the bottomland hardwood habitat which it requires is not reduced.

The turkey vulture (Cathartes aura) and black vulture (Coragyps atratus) occur and probably nest in the Nickajack area. Both species, listed as in need of management in Tennessee, nest in shallow caves on bluffs, in abandoned buildings, and in thick undergrowth in heavily wooded areas.

The federally endangered red-cockaded woodpecker (Picoides borealis) apparently no longer is found in the reservoir area. The species was reported in the Prentice Cooper State Forest and Wildlife Management Area in the late 1960s. In 1984, an abandoned colony site was observed in the Pot Point area of the State forest.

Two reptiles listed as in need of management by the State are fairly common in the Nickajack study area. The six-lined racerunner (Cnemidophorus sexlineatus) inhabits disturbed areas such as roadcuts and old fields. The Cumberland turtle (Pseudemys scripta troostii) is an aquatic species that is fairly common in shallow embayments.

One plant species listed by the Federal Government and one plant species which is a candidate for Federal listing occur in the study area. Five additional rare plant species are reported from the vicinity and are listed as endangered, threatened, or of special concern in Tennessee.

Large-flowered skullcap (Scutellaria montana), a federally endangered species of mint, occurs in several areas within the Tennessee River Gorge. The worldwide distribution of this mint is an area roughly 75 miles by 35 miles, centered in Chattanooga. Approximately 18,000 plants of mountain skullcap are known throughout its range and roughly 80 percent are in the gorge. The significance of the reservoir area is thus substantial.

Leafcup (Polymnia laevigata), a candidate for Federal listing, also occurs at several sites. This member of the sunflower family is found in moist, wooded areas on limestone soils. Many details of its life history and reasons for rarity are unknown.

American smoketree (Cotinus obovatus) and cylindric blazing star (Liatris cylindracea) are listed as endangered in Tennessee. American smoketree is a small- to medium-sized tree that grows on limestone bluffs or in dry, open woods. It occurs downstream from the gorge and is especially noticeable in midsummer when the fruiting trees develop their characteristic "smoky" cast. Cylindric blazing star occurs on only one area (Little Cedar Mountain) of the reservoir. This herb is 12 to 18 inches tall and is restricted to prairie-like or glade-like openings in limestone areas.

A single plant species is listed by the State of Tennessee as threatened. Ginseng (Panax quinquefolius) is reported from a few rich, wooded sites. Exact localities are not made public because of the commercial value of the roots of this species.

Hairy false gromwell (Onosmodium hispidissimum) and three-parted violet (Viola tripartita var. tripartita) are considered of special concern by the State of Tennessee. Hairy false gromwell is known from two sites along the reservoir: one on Little Cedar Mountain and one near the site of the old Hales Bar Dam. This species is restricted to open, limestone areas with thin soil. Three-parted violet is found only in rich, moist forested areas.

Wildlife

Nickajack Reservoir lands and adjacent waters provide habitat for a variety of waterfowl, upland, and wetlands wildlife species. In addition to a wide array of commonly occurring wildlife species, several threatened and/or endangered species, and/or species of special concern, as discussed above, are supported by the diverse habitats, ranging from mature upland forests to wetlands.

Wildlife Management Areas - There are no formally designated wildlife management areas (WMA) or refuges under license or easement to TWRA or the U.S. Fish and Wildlife Service on TVA's Nickajack Reservoir land base. Prentice Cooper State Forest and WMA, located on the north side of the Tennessee River Gorge, is managed by TWRA in cooperation with the Tennessee State Forestry Division. This 22,000-acre upland, predominantly wooded area is managed primarily for white-tailed deer and eastern wild turkey. Most users of the Prentice Cooper State Forest and WMA come from Marion and adjacent counties and the Chattanooga metropolitan area.

Wildlife Observation Areas (WOA) - WOAs are an important regional and national resource which have only recently begun to receive proper recognition. Revenues generated by tax deductible contributions have allowed TWRA to fund programs designed to accommodate that growing portion of the general public interested in the study, photography, and general non-consumptive enjoyment of wildlife.

Nickajack Cave WOA is the only TVA/TWRA WOA on Nickajack Reservoir. In addition, TVA's Raccoon Mountain Pumped Storage Facility is designated as a TVA WOA. This large pump-storage lake attracts several species of wintering waterfowl and, most notably, significant numbers of wintering bald eagles. As many as ten bald eagles have been observed at one time at this site during the overwintering period in recent years.

Cooperative Small Game Demonstration Areas - There is currently one cooperative small game demonstration area on TVA agricultural lands on Nickajack Reservoir. This area encompasses a 400 acre portion of the TVA land referred to as Little Cedar Mountain, located on the right bank upstream from Nickajack Dam. The Chattanooga Chapter of Quail Unlimited, a local wildlife conservation organization, entered into a cooperative agreement with TVA in April 1986 to develop wildlife habitat on these lands. The habitat management program is being accomplished through planting both annual and perennial varieties of small grains and shrubs of proven benefit to wildlife, and through the manipulation of native vegetation. TVA provides the land base, technical assistance, and some materials, while tractor work and labor are provided by the club. To date over 4,000 bicolor lespedeza seedlings and 900 pounds of small grain seed have been planted.

Riparian Shoreline - The riparian strip of TVA land from TRM 442 to 437, left bank, is an important buffer area to backlying roadside development and increasing shoreline development along the right descending shoreline of this portion of the Tennessee River Gorge. In addition to the excellent lowland forest stands in this area, there are several developing emergent and scrub/shrub wetlands along the reservoir shoreline. One particular wetland to note is located at the mouth of Harwood Gulf extending downstream to the mouth of Hugden Branch (TRM

441, left bank). This approximately 40-acre wetland developed following a large accretion of silt resulting from intense rainfalls in the spring of 1982. Wetlands of this type are uncommon throughout the Nickajack study area and provide breeding and feeding habitat for a variety of wildlife species.

White-Tailed Deer - By the early 1920s, white-tailed deer populations were almost extirpated in Tennessee and at a dangerously low level in the total Valley region. By 1950, all seven Valley States had active deer restoration programs. For many years, east Tennessee was the only portion of the State where deer were present in huntable numbers. In 1952, only 552 white-tailed deer were harvested in the entire State. However, by 1985 Tennessee's deer harvest reached a record total of 58,327 animals. The 1977 deer harvest in Marion County was 130 animals. By 1984, the harvest had risen to 466 animals, an increase of over 300 percent. The deer population within the Nickajack study area should continue to expand since the habitat within the study area is of good quality and the deer herd is below the support capacity of the land base.

Agricultural-Related Wildlife - Agricultural lands support a diversity of wildlife species including northern bobwhite quail, cottontail rabbits, mourning doves, songbirds, small mammals, and various furbearers. As land is removed from agricultural production, farm-related wildlife resources will continue to decline. However, public demand for such wildlife-related recreational opportunities is increasing.

Wood Ducks - Nickajack Reservoir presently supports a limited number of wood ducks in areas with suitable habitat. Most wood ducks on the reservoir are found between TRM 432 and 443 and are present during the spring, summer, and fall. Biweekly aerial surveys from June 1979 to October 1979 recorded an average of 22 wood ducks per survey.

Wood duck habitat on the reservoir appears to be stable at present, although development of the reservoir shoreline and destruction of riparian vegetation in wood duck use areas will have major impacts on this limited population. Wood ducks are an important regional resource and are intensively utilized by the hunting and bird watching public.

Resident Canada Geese - A flock of resident geese was established by TWRA on adjacent Chickamauga Reservoir in 1976 and currently numbers approximately 1,300 birds. Aerial surveys have sporadically recorded Canada geese on Nickajack Reservoir since 1977. Twelve geese were observed in December 1977; 4 in December 1980; 22 in January 1982; and 150 in June 1987. Although habitat for resident Canada geese is limited on Nickajack, the number of birds is expected to increase through natural reproduction and immigration of geese from surrounding reservoirs.

Migratory Ducks - Nickajack Reservoir supports moderate numbers of migrating and wintering ducks. Several species of dabbling and diving ducks are found on the reservoir with dabbling ducks the most common. The number of ducks on Nickajack can vary widely throughout the fall and winter as some migrating birds stop over and remain in the area for only a few days while others may stay the entire winter. Migrant ducks on the reservoir are closely associated with submersed aquatic bed vegetation, and larger concentrations of birds are found in areas

such as Bennett Lake, Mullins Cove, Browns Lake, and Cummings Lake. Based on biweekly aerial surveys conducted between October and March from 1977 through 1983, the number of migratory ducks per survey has ranged from a low of 209 (1977-1978) to a high of 750 (1979-1980).

The greatest impact on the amount and quality of wintering habitat for migratory waterfowl has come from the growth of the urban/industrial complex and changing agricultural practices. Habitat lost as a result of creation of the TVA reservoir system has been partially offset by management of the public land adjacent to the reservoirs and from increases in aquatic bed vegetation. Waterfowl habitat on Nickajack Reservoir is an important link along the migration corridors for many waterfowl species and is of regional significance. Waterfowl resources on Nickajack are used by both the hunting and nonhunting public.

Migrant waterfowl use and habitat on Nickajack will probably slowly decline in the next 10 years as urban development of the reservoir shoreline increases. Such development will lead to increased demand for aquatic plant control, which in turn will result in less available waterfowl habitat.

Wading Birds - The great blue heron is the dominant wading bird on Nickajack Reservoir and is most often found in shallow overbank areas which provide an abundance of fish for feeding. One hundred and five great blue herons were counted on Nickajack during the 1986 Tennessee Ornithological Society Christmas bird count. Great blue herons migrating from areas north of Tennessee also feed and rest on Nickajack during the fall and winter. Great egrets have also been recorded on Nickajack Reservoir during the late summer and early fall months of 1987.

No known nesting colonies of wading birds are currently located on Nickajack Reservoir. The number of great blue herons using this reservoir will probably increase steadily during the next 10 years if annual production from nesting colonies on adjacent reservoirs continues to increase as in recent years.

Gulls - Gulls are commonly found on Nickajack Reservoir during the fall and winter. Most of these birds are ring-billed gulls, with a few herring and Bonaparte's gulls present. In the Nickajack study area most concentrations of gulls are found roosting around exposed rock pilings and feeding above and below Nickajack Dam.

Biweekly aerial surveys since fall-winter 1977-78 have recorded peak counts of gulls ranging from a low of 24 (1978-79) to a high of 1,905 (1981-82). The most recent count as published in the 86th Audubon Christmas bird count includes 225 ring-billed gulls, 5 herring gulls, and 2 Bonaparte's gulls. Concentrations of gulls have recently received increased attention from bird watchers searching for rare species and from the general public interested in wildlife observation. Based on these uses, gull wintering and use areas on Nickajack Reservoir are considered regionally important. Inland gull populations are increasing regionally, and the number of gulls using suitable areas on Nickajack Reservoir will probably increase in the next 10 years.

Wetland Furbearers - Nickajack Reservoir is a productive area for wetland furbearers which rely on the maintenance of high-quality wetland/riparian habitats for their existence. Furbearers as a source of part-time income is significant in the Nickajack area. The total number of trapping licenses sold in Marion County for 1982-83 was 43. This was the highest number of trapping licenses sold within TWRA's 24-county Region III area and comprised 13 percent of the region's total. Statewide, wetland furbearers have considerable economic importance. For example, during 1982-83, the sale of muskrat, mink, raccoon, and beaver pelts totaled over \$1.08 million in Tennessee. The population of wetland furbearers within the study area should remain relatively stable over the next 10 years unless the market for furs increases significantly.